VEP Optometric Case Study

Reducing Rx Power in Refractive Amblyopia

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INTRODUCTION: A young child diagnosed with hyperopic anisometropic amblyopia came to us for office-based optometric vision therapy, with the goal of lessening the power difference in Rx between the two eyes without risking regression. **METHODS:** Using the ***Diopsys™ NOVA-TR VEP Vision Testing System*** (Diopsys, Inc; Pine Brook, NJ) we assessed the patient's vision at three separate check sizes, comparing OD, OU and OS conditions. **RESULTS:** We were able to obtain objective, reliable baseline data that will assist us in future monitoring of treatment efficacy. Specifically, we will now be able to know if reducing the power of the amblyopic Rx helps or hinders pattern vision and/or binocular summation. Also, we will know if the patient's binocular cortical summation remains stable as we follow-him post-therapeutically.

Presentation:

The male patient was first evaluated at age four and one half years old, having recently been diagnosed as having amblyopia for which the patient was given the following Rx:

OD: +2.00 sphere **OS:** +5.25 sphere

Entering visual acuities were:

OD: 20/25 with or without Rx **OS:** 20/200 without Rx and 20/40-2 with Rx

The patient complained of headaches when being patched, and exhibited fatigue. He came in wearing glasses, but frequently peered above them. His binocular profile showed exophoria with random dot stereopsis present. The patient's hyperactivity made it difficult for him to sustain fixation at near, and to accommodate accurately.

Assessment:

Parents of a child with hyperopic anisometropic amblyopia come to optometrists with the desire to not only help their child improve visual function through the Rx, but to ultimately reduce or eliminate the Rx without sacrificing visual function. Seeing the strong lens power required for the amblyopic eye reminds them that this is a relatively "weak" or "lazy" eye.

Therefore, a course of office-based optometric vision therapy was undertaken. Upon completion, visual acuity through the patient's spectacle Rx improved to 20/25 OS. More compelling, his unaided VA OS was now the same as his aided VA. The conventional explanation for this is that the patient had learned to accommodate more precisely through his left eye as a result of vision therapy, as it is common for patients with amblyopia to have substandard accommodation.

Diagnosis and Treatment:

Pursuing a goal of lessening the power difference in Rx between the two eyes, we reduced the patient's Rx to +4.50 OS from +5.25, and subsequent visits showed that he was able to hold steady at 20/25 with or without Rx OS. We wondered if we could be more aggressive in reducing the Rx without risking regression. It was obvious that even though the patient could identify Snellen letters well with his left eye, he needed to work harder to resolve the letters than with the right eye, and was still subject to some crowding.

At the time of the initial evaluation we did not have the ***Diopsys™ NOVA-TR VEP Vision Testing System*** in our office. We therefore have no data that served as a baseline prior to vision therapy. When the patient came in with his mother for their last visit, I advised her that we now had a more sensitive baseline measure available to establish, which would help guide us in monitoring:

a) if there has been regression in visual function and
b) when and if it is appropriate to reduce the patient's spectacle Rx further.

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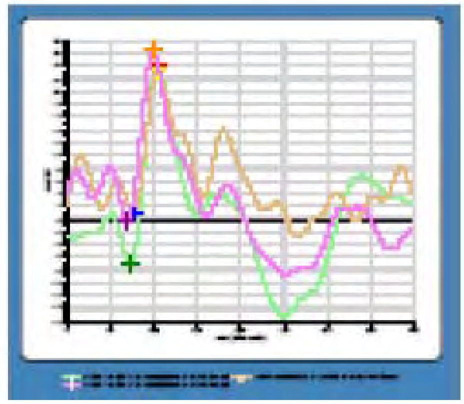
We recorded his VEP under the same conditions, wearing his habitual Rx, with three different check sizes, 16, 30 and 60.* We selected these check sizes because they were reasonable at maintaining interest for a 6 year-old active child. Any size smaller would not have held the patient's attention. Contrast was held constant at 85% and test time for each condition was a 20 second viewing time.

We superimposed the results from OD, OS, and OU for comparison, and there are several significant results to note from the following graphs and tables. For reference, the graphs correspond to green for OD, magenta for OS, and brown for OU. We examined three characteristics of the VEP: overall waveform, latency, and amplitude.

Traditionally, the most reliable variable clinically is the latency for the P100 value, or the rise of the waveform to its peak around the 100 millisecond (ms) time frame on the scale. Even though the amplitude of the wave (distance from trough to peak) can be more variable, some insights can be gained by their inspection as well.

Figure 1 shows that, for the largest check size we used (16), the waveform appearance is similar for all three conditions, OD, OS and OU.

Figure 1



	T=20-P=16-OD-85%-C- 6/16/08 10:19:30 AM Filtered	T=20-P=16-OS-85%-C- 6/16/08 10:18:43 AM Filtered	T=20-P=16-OU-85%-C- 6/16/08 10:15:44 AM Filtered
Left Cursor	73.33 ms	76.66 ms	70.00 ms
	-6.9 uV	0.94 uV	[illegible]
Right Cursor	105.0 ms	105.0 ms	100.0 ms
	23.9 uV	23.5 uV	26.3 uV
Delta	31.66 ms	28.33 ms	30.00 ms
	30.9 uV	22.5 uV	26.8 uV
Eye	OD	OS	OU
CheckSize	16	16	16
Test Time	20	20	20
Contrast	85	85	85
Pattern	Checkerboard	Checkerboard	Checkerboard
Binasal	N	N	N
Filtered	Y	Y	Y

The latency values seen at point P1, or the values marked for the Right Cursor in the table, are:

OD: 105.0 ms **OS**: 105.0 ms **OU**: 100.0 ms

This showed that transmission time for the signal to be processed in the occipital lobe, more specifically in V1 of the visual cortex, was identical for the right and left eyes independently, and that there was summation in speed of transmission when both eyes were viewed together. The normal summation is around 10% and this was 5%. But the key is that when there is clinically significant suppression or interference from the amblyopic eye under OU conditions, not only might summation be absent, but the latency might actually slow down slightly under OU conditions.

Although not typically as reliable a finding, when we look at the amplitude of the wave in microvolts (uV), from N1 to P1, or left cursor to right cursor (delta), we note the following delta values in the table:

OD: 30.9 uV **OS**: 22.5 uV **OU**: 26.8 uV

*The largest check size is the smallest number, since it counts the number of black and white checks that occupy the screen at the 1 meter viewing distance.

VEP Optometric Case Study (cont.)

So in this instance the amplitude was lower through the amblyopic eye (OS) as compared to the dominant eye (OD), and appeared less in OU than through the non-amblyopic eye.

The results for the mid-size checks we used (30) showed that the appearance of the waveforms was nearly identical for the OD, OS and OU conditions. The latency values seen at point P1, the values marked for the Right Cursor in the table, were:

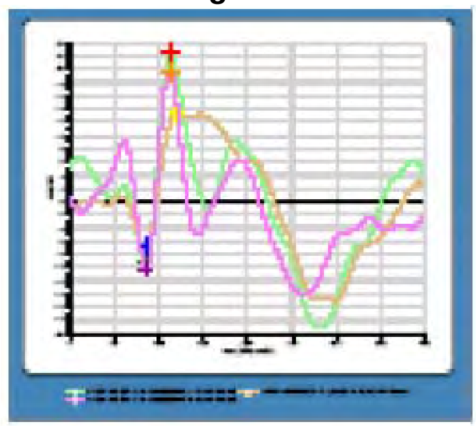
OD: 108.3 ms **OS**: 110.0 ms **OU**: 106.0 ms

As compared to the larger check sizes, P100 showed slightly reduced latency OS relative to OD for these check sizes. However, as with the larger check sizes, there was still a small summation rather than inhibition effect for the OU condition.

The amplitude or delta value at this check size was the same for the OU condition as it was for the OS condition, both less than the OD condition.

Lastly, we looked at results for the smallest check size (60) of the three presentations.

Figure 2



As can be seen in **Figure 2,** the waveform of the amblyopic eye was significantly different from both the OD dominant eye recording, and the OU recording immediately around the P100 value.

The corresponding values for **Figure 2** are as follows:

	T=20-P=60-OD-85%-C- 6/16/08 10:21:47 AM Filtered	T=20-P=60-OS-85%-C- 6/16/08 10:20:43 AM Filtered	T=20-P=60-OU-85%-C- 6/16/08 10:16:58 AM Filtered
Left Cursor	85.00 ms	85.00 ms	[illegible]
	-9.2 uV	-6.9 uV	[illegible]
Right Cursor	113.3 ms	120.0 ms	113.3 ms
	22.4 uV	13.2 uV	19.7 uV
Delta	28.33 ms	35.00 ms	28.33 ms
	31.6 uV	20.1 uV	29.9 uV
Eye	OD	OS	OU
CheckSize	60	60	60
Test Time	20	20	20
Contrast	85	85	85
Pattern	Checkerboard	Checkerboard	Checkerboard
Binasal	N	N	N
Filtered	Y	Y	Y

The latency values seen at point P100, the values marked for the Right Cursor in the table, are:

OD: 113.3 ms **OS**: 120.0 ms **OU**: 113.3 ms

For these, the smallest check sizes presented, P100 now showed significantly reduced latency for OS as compared to OD. There was no longer a summation effect on OU recording, as the latency OU was equal to the latency for OD, the dominant eye. The amplitude or delta value at this check size was the same for the OU condition as it was for the OD condition, both greater than the OD condition.

Summary:

We can summarize the three sets of data as follows:

1. As the check size gets progressively smaller, there is a point at which cortically the pattern is being processed solely by the non-amblyopic eye, the electrophysiological correlate of central suppression in the presence of normal binocular motor alignment.
2. The latency of the P100 is the most reliable index, both for the differences between OD and OS, and for binocular summation.
3. The waveform appearance generally supported the observations of #1 above.
4. The amplitude of the P100 wave was not a reliable index of amblyopic function in this series.

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Given the baseline the patient was able to provide, we now have data that will assist us in the future in monitoring:

a) If his binocular cortical summation pattern remains stable as we follow him post-therapeutically.
b) If reducing the power of the amblyopic Rx helps or hinders pattern vision.
c) If reducing the power of the amblyopic Rx helps or hinders binocular summation.

Lastly, we note that the patterns used in this series were filtered. The ***Diopsys^{TM} NOVA-TR VEP Vision Testing System*** gives the clinician the option of looking at graphs filtering out noise, or at unfiltered data. For young children we prefer to use the filtered data to minimize noise. Owing to attention factors and movement of the patient, particularly with young children, we have learned the quality and transmission properties of the VEP can look poor on any given recording. We have developed a protocol where we repeat each condition twice. In this instance we did each of the three check sizes twice for the OD, OS and OU conditions respectively. We used the data giving the better waveform for each of the conditions. It is crucial that a clinician never assume that changing one variable, such as check size or the change of lens Rx had a specific effect, when recording only once for each condition.

About the Author: Leonard Press, OD, FCOVD, FAAO currently runs his practice, Family Eyecare Associates, P.C., in Fairlawn, NJ. He is an Associate Professor at S.U.N.Y. where he teaches two courses, one in children's vision, and the other in analyzing patient data. Dr. Press is a member of the Associate Medical Staff at St. Lawrence Rehabilitation Hospital in Lawrenceville, NJ. He is also a Fellow of the College of Optometrists in Vision Development and a Diplomate in Binocular Vision and Perception of the American Academy of Optometry. He is one of only two eye doctors in New Jersey who have specialty certification from both of these organizations.